

We obtained an excellent agreement in both images and parametric values. This simulation requires many experimental parameters that were obtained through the Ronchigram analysis, namely, the wavefront aberrations, the system f -number and the location of the Ronchi ruling, which speaks favorably of both the accuracy of the numerical simulation and the parameters retrieved from the experimental Ronchigram analysis. This agreement over the set of Ronchigrams also indicates the accuracy of the rather complicated process for the numerical simulation.

4. Summary

We have validated the quantitative Ronchigram analysis with a detailed numerical simulation of propagation through our experimental setup, and shown that the parameters determined by the Ronchi test are capable to reproduce, in a great detail the measured Ronchigrams. This agreement confirms the values of the parameters obtained from Ronchigram quantitative analysis, such as $F/\#$, the relative locations for the ruling with respect to the paraxial image point, and wavefront aberrations.

The numerical propagation additionally provides a useful framework to study in detail the effects of noise and accuracy and range of this wavefront sensing technique, with the possibility to explore several experimental variations such as grating period, optimal distance to the paraxial image plane, etc.

Furthermore, with some analogy to our experimental approach, phase retrieval techniques that perturb the beam by translating an object in the path of the beam are currently being applied to x-ray beam characterization [2]. A direction of further work could be to apply phase retrieval methods to the Ronchi test data, since with the Ronchi test we can retrieve all parameters needed for the numerical modeling of the data then it is feasible to think about applying phase retrieval as a refinement strategy for the wavefront estimation.

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